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APOLLO MONTHLY PROGRESS REPORT (u)

NAS9-150

April 1, 1964

Paragraph 8.1, Exhibit I

Report Period

February 16 to March 15, 1964

[redacted]

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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ILLUSTRATIONS

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PROGRAM MANAGEMENT

STATUS SUMMARY

Boilerplate 12 was shipped to the White Sands Missile Range during the report period to be prepared for the high-altitude launch escape subsystem abort test.

The command module, heat shield, and associated GSE of boilerplate 13 were shipped to Cape Kennedy.

The canard concept of aerodynamic stability was adopted for low-altitude aborts, replacing the dual mode tower flap design.

The adoption of water recovery as the primary recovery mode of the Apollo mission, with ground landing as the backup or emergency mode, was made during the report period.

The service module and adapter for boilerplate 26 were prepared for shipment to the Marshall Space Flight Center, Huntsville, Alabama, for installation of micrometeoroid measurement instrumentation. Shipment will be made during the beginning of the next report period.

A successful drop test of boilerplate 19 was conducted at the El Centro Naval Air Facility. After brake chute disconnect, the vehicle was in free-fall descent for 11 seconds, the longest free-fall time in a test so far. Stability of the primary drogue chute was satisfactory, and the emergency backup drogue was not needed. Descent on the main ring-sail chutes was stable and normal to impact.

Two successful dual parachute drop tests were conducted at El Centro during the report period. The purpose of one test was to evaluate the effect of midpanel reefing, and the other to evaluate the functioning of the main chutes when using redundant reefing.

S&ID was established as the sole responsible agent for test site activation at Downey, WSMR, MSC, and Cape Kennedy. A program organization was formed to fulfill this function.

SUPPLEMENTAL AGREEMENTS, CONTRACT NAS9-150

Supplemental Agreement 17, which provides for the incorporation of revisions to Exhibit F, Priced Spare Parts List, was executed by S&ID and forwarded to NASA for signature.

Supplemental Agreement 18, which incorporates contract change authorizations negotiated to date, has been executed by S&ID and returned to NASA for signature.

Supplemental Agreements 19 and 20, which provide for discontinuance of effort on Saturn I airframe adapters, have beeen executed by both S&ID and NASA.

FIELD ENGINEERING AND TRAINING

The March revision of the Apollo Training Plan was published and distributed.

The management decision for flow and interface of organizations related to trainers was identified during a meeting on March 13, 1964.

Manuscripts for the electrical power subsystem study guide and a revision to the stabilization and control subsystem study guide have been completed.

LOGISTICS ENGINEERING

Several items of GSE needed at WSMR for the support of boilerplate 12 were delivered. These include the pyrotechnic substitute unit and the weighing kit.

Support of boilerplate 13 at the Florida facility has been augmented by the receipt of the signal conditioner. The cable set will be complete after acceptance by S&ID of one cable unique to the assembly.

Supply Support

Supply support personnel attended meetings with Pratt & Whitney representatives to resolve problems pertinent to the design, procurement, and support of the fuel cell powerplants.

Support Manuals

The basic issue of Apollo Support Manuals for boilerplates 12 and 13, providing operational test procedures, was completed and delivered to NASA during the report period.

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DEVELOPMENT

AERODYNAMICS

The NASA/S&ID technical management meeting of February 25, 1964, resulted in the decision to adopt the canard concept in lieu of the tower flap design to achieve aerodynamic stability during a launch abort. Studies to implement the canard concept were begun. The optimum sequencing of the canard subsystem is being investigated; it includes consideration of these events: canard deployment, launch escape subsystem (LES) jettison, drogue initiation, and drogue disconnect. Deployment conditions for the main parachutes and pad abort range capability will be optimized.

The boost vehicle angle of attack and pitch rate limits for activation of the launch escape system abort cycle were presented by S&ID at the twelfth meeting of the crew safety systems panel. The data presented were for slow divergence type booster failure.

The ballast and center of gravity of boilerplate 12 were reevaluated to reduce the launch angle to 84 degrees to meet range safety requirements. The test point for simulating the abort is at Mach number = 0.94, dynamic pressure = 586 psf, pitch angle = 57 degrees, and altitude = 20,630 feet. Based on a 9200-pound command module, with the center of gravity at X_a = 1042 inches, the required LES ballast is approximately 600 pounds.

The boilerplate 13 mission sequencers are undergoing field tests at Cape Kennedy. The low- and high-temperature nonoperating tests were completed on the mission sequencer. The LES sequencer and humidity tests are in progress; temperature, vibration, and altitude tests were completed. Salt spray tests, requiring approximately one week, will follow.

MISSION DESIGN

A flight trajectory was computed for the spacecraft 009 "short lob" mission. This is the heat shield test using the Saturn IB booster launched at 105 degrees azimuth. All major performance ground rules are fulfilled. The trajectory profile was shaped for entry at 3181 nautical miles downrange so that continuous tracking, telemetry, and command capability could be maintained throughout at least 90 percent of the flight. After the S-IVB burnout, the vehicle coasts for 315 seconds; then the service propulsion subsystem (SPS) fires for 234 seconds. The SPS provides downward acceleration. After coasting for 15 seconds, the SPS is reignited and burns for 10 seconds. This will provide SPS restart evaluation. After the final SPS cutoff, the command module coasts 96 seconds before entry at 400, 000 feet altitude at 29, 062 fps with a -5. 0-degree entry angle. If the SPS fails to ignite, the entry angle would be -8. 5 degrees with a resultant load less than the maximum allowable load of 15 g's. Tracking can be provided by Cape Kennedy, Eleuthera, Grand Bahama, San Salvador, Grand Turk, Antigua, San Juan, and Ascension.

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Additionally, two ships are to be stationed for critical tracking and command capability between San Juan and Ascension.

A precision transearth trajectory program developed for a digital computer is now operational. The program can converge on returns north or south of the equator with short and long entry range solutions. The program requires, as inputs, the position and velocity vectors at some point in the final lunar parking orbit and the following three terminal constraints: entry altitude and angle, inclination to the earth equator plane, and landing site latitude and longitude. The independent variables to be computed are the position in the lunar parking orbit where transearth injection must occur, the transearth injection velocity, and the transearth injection plane change. The computer calculates a series of continuously corrected trajectories until it produces the one which satisfies all constraints.

A preliminary study was made of midcourse ΔV requirements for transearth trajectories as a function of transit time and inbound inclinations. The study was made to determine required ΔV allocations for transearth midcourse guidance. Inbound inclinations of 0, 30, and 60 degrees were used with transit times ranging from 60 to 110 hours. Results show that, for a given transit time, the ΔV cost varies with inbound inclination angle. For a 60-hour transit time, the cost of ΔV for trajectories with an inbound inclination of 60 degrees is approximately 119 fps (rms); for a 30-degree inclination, approximately 90 fps (rms); and for a 0-degree inclination, approximately 83 fps (rms). Results also show that the ΔV requirement varies inversely with transit time for all inclinations. A stabilization and control subsystem (SCS) backup for transearth injection was assumed in all cases.

A study was made of the performance of the ground operational support system (GOSS) in deriving navigation parameters. The results were compared with the performance of on-board navigation equipment. Preliminary results of the study show that:

1. There is a significant advantage if track is acquired immediately after translunar injection for translunar midcourse navigation

2. The advantage is not shown for this transearth midcourse phase

3. The performance of GOSS is at least 10 to 20 times better than the on-board navigation equipment for an average timeline

4. By processing deep space instrumentation facility (DSIF) range information on board, with a well distributed timeline of DSIF measurements, navigation performance is 10 times better than when only sextant-derived navigation data are used.

[redacted]

CREW SYSTEMS

Phase I of the crew transfer tests, using a mock-up of the command module-lunar excursion module transfer tunnel, has been completed. The ability of the subjects to remove and install hatches and docking mechanisms in the tunnel was tested. The test subjects, wearing Phase-A pressure suits, were suspended and counterbalanced in a special torso harness to gain maximum degrees of freedom to simulate some aspects of weightlessness. The entire tunnel mock-up was mounted on an air-bearing (levipad) frictionless table. The hatches and docking mechanisms were supported by counterweight devices. A report giving detailed test results and recommendations will be completed during the next report period. Preliminary results of the test indicate that the crew can perform the required removal and installation tasks.

Phase II of the tests is now under way. Test subjects will wear Phase-A pressure suits, and, as soon as they are available, Phase-B pressure suits. This Phase-B garment was demonstrated at Hamilton Standard recently and again at Downey to S&ID and NASA personnel on March 4, 5, and 6, 1964. Crew couch restraint-suit interface problems were studied, and a report is being prepared. Additional studies are planned.

STRUCTURAL DYNAMICS

Dynamic flotation characteristics of the command module in random sea conditions are being tested on a tenth-scale model at Stevens Institute of Technology, Hoboken, New Jersey. The objective of the test program is to determine whether, in various sea states, the hydrodynamic forces can shift the module from the upright stable attitude to the overturned stable position. Analytical calculations indicate that the command module will pitch from the upright to the overturned position and vice versa. A secondary objective of the tests is to measure pitch angles about both stable positions to verify predictions that water will enter the open crew access hatch.

Plans were implemented for a full-scale command module flotation test vehicle, to be designated boilerplate 29. This vehicle will simulate spacecraft characteristics of weight, mass distribution, flooded volume, and water absorptivity of ablative and insulation materials. It will be used at Downey and at sea in the vicinity of Los Angeles to determine the flotation characteristics.

Initial vibration tests of the service propulsion subsystem (SPS) fuel tank were completed by Allison at the Bendix plant at Ann Arbor on March 6, 1964. The tank was filled with simulated fuel and vibrated in each of three axes over a range of 10 cps to 2000 cps. No adverse sloshing effects and no prominent structural resonances were noted. Further testing on a partially filled tank is being scheduled.

Details of in-flight vibration, acoustic, and fluctuating pressure measurements for boilerplate 22 and spacecraft 002 flights are being developed by S&ID and MSC. Inclusion of the measurements originally scheduled for the cancelled boilerplate 18 will require extensive rearrangement of instrumentation. This vehicle was to have been the initial demonstration of a spacecraft service module. The vehicle was heavily instrumented to verify the structural integrity of the reaction control subsystem (RCS) and the service module honeycomb shell structure.

STRUCTURES

Light transmission tests for a 45-degree angle of incidence were completed on a simulated command module observation window. The results are expressed as percentages of the light transmission obtained at 90 degrees. All ultraviolet and 98 percent of wavelengths above 800 millicrons were cut off. Approximately 90 percent of the visible spectrum is transmitted. The small difference in the visible spectrum between a 90-degree and a 45-degree angle of incidence is not detectable by the human eye.

A comprehensive study was made to determine the feasibility of replacing the astrosextant doors with a fixed window. The study indicated that the doors must be retained in order to protect the optics from exposure to extremely high temperatures (approximately 3800 F).

The launch escape tower of boilerplate 12 was analyzed for loads anticipated during vertical transport at WSMR. The results show that the structure is adequate for this method of handling.

The first bonding operation was completed on the command module of spacecraft 006. The command module is shown in Figure 1 as it appeared in the assembly drill rig before the drilling of the holes for the launch escape tower.

Agreement on the design concept for the service module destruct system was reached by S&ID and NASA. The concept provides for in-flight dispersal of service module propellants in low- or high-altitude aborts as a range safety measure. Four conical shaped charges are mounted in the adapter. The charges will shoot upward through the service module heat shield and pierce the propellant tanks. An alternate test program instead of a full-scale destruct system demonstration will be submitted to NASA in the near future.

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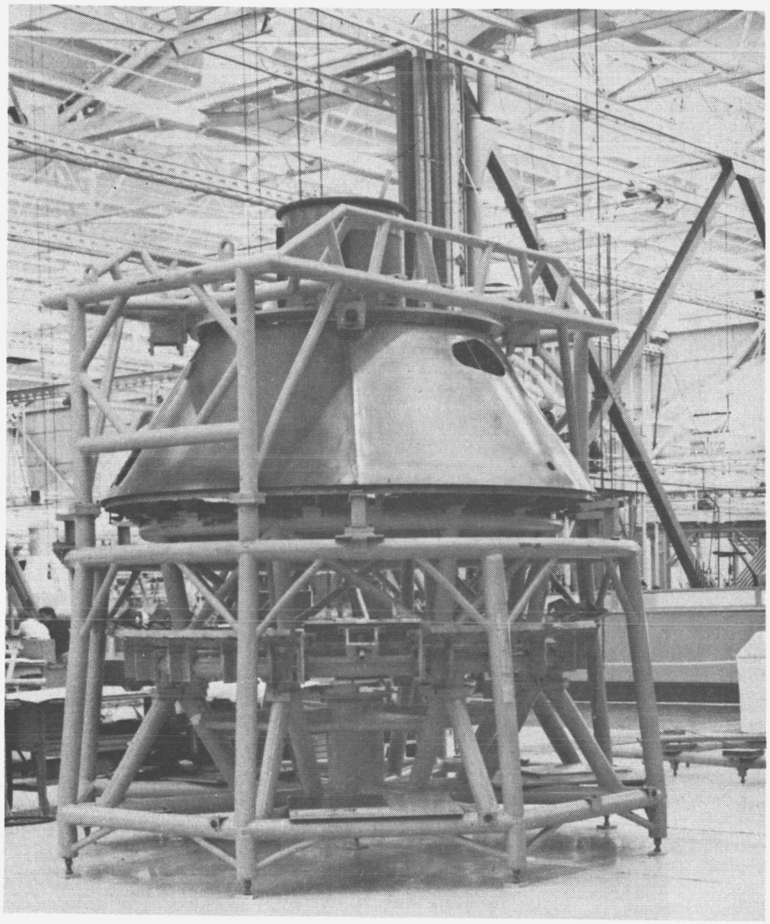

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Figure 1. Spacecraft 006 Command Module

The last of the two helium tanks required for spacecraft 001 was received from Airite Products, Division of Electrada. These two tanks plus the four propellant tanks received from the Allison Division of General Motors Corporation complete the vehicle SPS tank requirements. Figure 2 shows one of the SPS fuel tanks undergoing qualification tests at Allison.

FLIGHT CONTROL SUBSYSTEM

Stabilization and Control Subsystem (SCS)

Honeywell is performing development tests on functional models A and B of the attitude gyro accelerometer package. The pitch electronic control assembly (ECA) and six cards are being instrumented for thermal tests. Vibration tests are being conducted on the yaw ECA. The roll ECA's are undergoing interchangeability tests and electrical tests. A method was

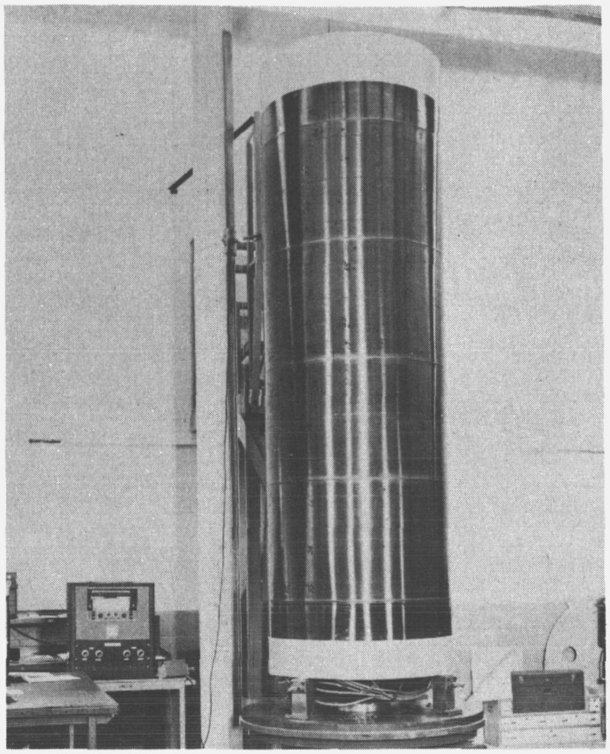

Figure 2. Service Propulsion Subsystem Fuel Tank

developed for connecting the attitude gyro coupling unit (AGCU) breadboard into the analog computer to evaluate AGCU errors during high-rate maneuvers.

Electronic Interfaces

Measurements to be monitored by the in-flight test subsystem (IFTS) were reduced so that the IFTS will have 72 instead of 150 analog comparator channels. The original size of the IFTS is being reduced from 28 inches by 14 inches by 7 inches to 28 inches by 9 inches by 6 inches. The change can be made without schedule slippage. Weight will be reduced an estimated 11 pounds.

A recent reliability analysis showed that the inherent reliability of the caution and warning subsystem detection unit precludes the need for in-flight maintenance capabilities. This change will decrease weight, volume, and power requirements. Autonetics has been directed to implement these changes.

[redacted]

Subsystem Analysis

Studies are nearly complete regarding three aspects of thrust vector control (TVC) failure of the stabilization control subsystem that may occur during service propulsion subsystem thrusting maneuvers. These three aspects are performance capability for thrust interruption, manual deletion and isolation of failure, and manual control feasibility. Preliminary results indicate that:

1. An SPS thrust interruption not exceeding 10 minutes can be tolerated during any thrust maneuver on a lunar mission.

2. All SCS signal flow failures in the guidance and navigation (G&N) ΔV mode can be detected by the astronaut using the present displays. The SPS engine can be shut down and the vehicle controlled manually without exceeding the limits of the inertial measurement unit.

3. All SCS signal flow failures in the G&N ΔV mode can be isolated within some 4 minutes using the present controls and displays.

Data analysis from recent subsonic wind tunnel tests to determine command module aerodynamic damping coefficients resulted in studies of the command module dynamic behavior during the terminal phase of flight. The conclusion was that the present command module RCS capability is adequate.

TELECOMMUNICATIONS

Communications

The audio communications center of the main display panel was demonstrated to NASA astronauts to determine the relative volume levels desired for mixed intercom and receiver signals. The astronauts indicated that a capability of reducing the receiver signal to a point at least 6 decibels below the intercom signal was desirable. As a result, a capability for a reduction of 10 decibels is being incorporated.

The feasibility of using the 8-to-14-megacycle HF transceiver while in earth orbit for beyond line-of-sight communications is being investigated. This transceiver is currently designed for post-landing recovery.

[redacted]

A manually tuned antenna coupler for the HF transceiver is being studied to establish the optimum match of the transmitter to the recovery antenna and improve the efficiency of the unit.

Redundant up-data link signals are to be furnished to actuate an abort request indicator lamp in the command module. The signals would be activated by the range safety officer to warn the crew of an imminent abort.

The television camera was received for boilerplate 14, the first house spacecraft. The camera will be used to determine compatibility with other communications equipment. This unit contains micro-module components in its circuitry. The subcontractor has been authorized to use integrated circuits in the cameras yet to be delivered because the availability of the micro-module components is limited.

A multiplex simulator is being constructed for use in experiments to find the best modulation indices for the unified S-band equipment. This device will optimize the ground-to-spacecraft link by providing variable control of the modulation of the subcarrier oscillators used to modulate the unified S-band equipment. The results obtained will be used to support spacecraft-to-GOSS interface tests.

Instrumentation

The schedule status of instrumentation subsystem components was improved during the report period, particularly on constraints on boilerplate 14, test fixture F-2, and spacecraft 001, 006, 008, 009, and 011. PERT reporting indicates schedule improvement for all vehicles. The pacing vehicle, spacecraft 008, shows an improvement of 11 weeks, from a negative slack of 48 weeks on February 7 to 37 weeks of negative slack on March 13. Improvement within the next 2 weeks is predicted.

ENVIRONMENTAL CONTROL SUBSYSTEM (ECS)

The ECS performed according to design requirements during the integrated systems checkout of boilerplate 13.

Burst pressure tests were performed on seven ECS coldplates that were fabricated with revised techniques for cleaning, silver plating, and eutectic pressure bonding. The lowest burst pressure was 800 psig and the highest was 1770 psig. The burst design pressure is 150 psig.

The potable water supply valve is being revised to meter both hot and cold water in increments of 1.0±0.05 ounce, providing accurate measurements for food rehydration. The previous water supply valve was a full-flow tap.

[redacted]

The latest series of urine dump tests was completed, and a technique was developed to prevent icing in the end of the urine dump line. Icing occurs inside the line after the fluid is released by the dump valve because of fluid expansion when exposed to the vacuum of space. By replacing this valve with a solenoid needle valve at the end of the dump line, expansion of the fluid takes place outside the end of the line. The effects of incorporating this technique into the waste management system are being evaluated.

Using the Avco two-temperature subliming-ablation technique, thicknesses of ablative heat shield material were computed for constant thermal conductivity and temperature-dependent thermal conductivity. The thicknesses calculated with assumed constant conductivity agree with those determined by Avco in December 1963. The thicknesses computed for temperature-dependent conductivity agree with those reported by Avco in February 1964 for stations subject to low and medium heating rates, but are slightly higher than those reported for stations having high heating rates. The thicknesses computed with assumed constant conductivity result in a heavier heat shield than do those computed with variable conductivity.

The first AiResearch production hardware for boilerplate 14 was received on March 3. The shipment consisted of 19 component end items.

The environmental control subsystem breadboard test facility (bell jar) is being modified to permit manned evaluation tests under a vacuum of 10^{-4} millimeters of mercury for periods up to 14 days. This change includes the safety and life support provisions required for three test subjects; revision of the test procedures and program; and design, selection, and installation of hardware needed in addition to that provided for the unmanned tests. Upon completion of this work, real-time manned tests can be conducted in a vacuum to study physiological and psychological problems, and to evaluate equipment and operating techniques.

ELECTRICAL POWER SUBSYSTEM (EPS)

Westinghouse completed the first unpotted static inverter for engineering evaluation, and tests were begun. This inverter weighs 36.6 pounds without potting. The final potted weight is estimated at less than 38 pounds. The second evaluation unit is being fabricated.

The first four battery chargers were assembled and tested by IT&T. The function of the charger is to maintain the entry, post-landing, and portable life support system batteries. The four chargers were delivered during the first week in March.

Pratt & Whitney experimental fuel cell powerplant 406 passed 469 hours on continuous load in a vacuum chamber. At that time the powerplant was still within the performance requirements of the Prototype B specification and nearly within the requirements for ultimate qualification hardware. From the beginning of the test, cell 11 showed some reduced power output relative to the other cells. Because the relative output remained approximately constant, it is believed that the cause may be a gas bubble and that modification of test procedures may eliminate future occurrence.

EPS radiator performance data for one hour were computed from the detailed transient heat balance network for one fuel cell powerplant operation and a 24-square-foot radiator panel facing the moon. Partial evaluation of the data indicates that unequal distribution of fluid flow to the parallel radiator tubes reduces performance by 30 percent on the dark side of the moon and by 20 percent on the light side. The loss of performance is an advantage on the dark side because it allows the use of larger radiator areas that would otherwise dissipate too much heat. If a similar loss occurs with two or three powerplants operating, it may be possible to use all of the EPS radiator area during those portions of the mission involving a minimum heating environment. The radiator performance loss in high heating environments will be studied further to determine its over-all effect on system operation.

Beech Aircraft, using liquid hydrogen, tested a titanium pressure vessel for proof pressure, leakage, and burst. A ductile fracture occurred in the upper hemisphere at 1134 psig and a recorded temperature of -368 F. Over-all performance was excellent and within all specification limits.

The electrical wiring mockup installation was completed for the command module of boilerplate 14. All electrical schematics for boilerplate 22 were released, and the initial release of all vehicle wiring diagrams and command module electrical installations were completed for spacecraft 006.

Shock tests at 78 g were completed on readily available circuit breakers. The results were satisfactory, except that the 0.5- and 1-ampere, 3-phase circuit breakers tripped when shock was applied in one direction along the solenoid axis. This problem could be remedied by solenoid orientation to avoid severe axial shock.

The advisability of replacing the vehicle wiring diagrams with an automated wire list was evaluated. The study determined that, while the automated wire list may require more engineering effort, the advantages outweigh the extra effort required. A plan is now being formulated to employ this technique.

PROPULSION SUBSYSTEM

Service Propulsion Subsystem (SPS)

During this report period, 120 firings were accomplished in the injector development program at Aerojet-General. Intermediate frequency vibrations of 600 cps were encountered with the POUL-31-39 injector pattern. Investigation is in progress to determine the cause of the vibrations.

Firing results for this report period are given in Table 1.

Four firings were conducted at the Arnold Engineering Development Center (AEDC). Two firings on engine AEDC 1B were satisfactory. The first firing on engine AEDC 3 also was satisfactory. During the second firing, however, the diffuser broke down, resulting in major damage to the nozzle extension. Several modifications will be made before the next firing.

Water flow pressure drop tests were conducted on the fuel and oxidizer systems of test fixture F-3. Instrumentation problems encountered early in the testing were corrected. Subsequent testing produced satisfactory data.

Reaction Control Subsystem (RCS)

Marquardt is continuing tests of the first two engines, incorporating the film cooling technique proposed for the prequalification design. (Film cooling introduces excess fuel into the chamber so that it forms a film on the chamber wall and acts as a cooling agent.) Both engines have demonstrated consistently low chamber wall and flange temperatures during steady-state tests. Data are being obtained to determine engine pulse performance.

Rocketdyne successfully completed testing of the second engine. A graphite-ceramic throat insert was incorporated.

The development verification test program for the command module RCS burst diaphragm is in progress. Four units underwent one week of the propellant exposure test. Endurance cycling tests were completed on three of the four remaining units.

[redacted]

Table I. Injector Development Test Program—Apollo Service Propulsion Subsystem Engine

Serial Number	Pattern Type	Type of Evaluation	Number of Firings	Number Unstable	Total Time (sec)	Remarks
AFF-16	POUL-31-10	Face crack propagation	28		673.0	Crack was slightly longer.
AFF-28	POUL-31-39	Intermediate frequency vibration investigation	7	1	35.0	600 cps was evident during tests. Injector was in engine assembly 0005.
AFF-29	POUL-31-39	Intermediate frequency vibration investigation	1		5.3	600 cps evident
AFF-32	POUL-31-39	Injector chamber compatibility	1		101.3	No gouging and slight streaking
		Prototype determination	2		91.21	600 cps evident
		Mission duty cycle	25		564.0	Two holes burned through chamber wall Eight inches downstream of injector flange.
		Intermediate frequency vibration investigation	15		473.0	600 cps intermittent
		Performance evaluation	3		17.7	600 cps evident
AFF-53	POUL-31-10	Injector acceptance test	7		42.5	Satisfactory
AFF-58	POUL-31-10	Simulated acceptance test	2		33.0	Valve malfunction occurred on first test.
		Simulated checkout	1		61.0	Satisfactory
		Mission duty cycle	12		475.0	Test was discontinued because of heavy gouging.
		Injector chamber compatibility	2		502.0	0.75-inch hole burned through chamber wall 5 inches below injector flange. 900 seconds on chamber

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Table I. Injector Development Test Program — Apollo Service Propulsion Subsystem Engine (Cont)

Serial Number	Pattern Type	Type of Evaluation	Number of Firings	Number Unstable	Total Time (sec)	Remarks
AFF-19	POUL-41-8	Induced instability	2		10.5	Satisfactory recovery from 156.9 grain charge
AFF-18	POUL-41-8	Performance evaluation	3		16.0	Satisfactory
0007 AFF-54	Engineering Assembly POUL-31-10	Balance	3		73.3	Engine removed because of unsatisfactory valve operation
0005 AFF-28	Engineering Assembly POUL-31-39	Balance	1		21.0	600 cps evident
		Simulated acceptance test	1		70.5	600 cps evident
		Mission duty cycle	4	1	33.4	600 cps evident; last firing terminated by combustion system monitor.
AEDC 1B AFF-24	Engineering Assembly POUL-31-10	Simulated high altitude	2		265.0	Satisfactory test with 12:1 titanium nozzle extension
AEDC 3 AFF-23	Engineering Assembly POUL-31-10	Simulated high altitude	2		98.0	Diffuser breakdown resulted in damage to the 12:1 stiffened titanium nozzle extension.

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The service module RCS is being changed to provide backup emergency capability for retrograde from earth orbit. This change is to be accomplished by increasing the continuous burn requirements of the service module RCS engines to 500 seconds from 60 seconds.

Launch Escape Subsystem (LES) Motors

Launch escape motor ED-30 was fired at 140 F on February 10 at the Potrero test facility. ED-32 was conditioned to 20 F and fired at 20 F with a single igniter cartridge on February 26. These two were the last of six development motors scheduled to verify the 31-percent ground oxidizer ratio. Launch escape motor ED-39 was cast on February 21 with a 31-percent oxidizer ratio. Data are being analyzed.

The third pitch control motor with 31-percent ground oxidizer was successfully fired on February 12 with a single hotwire igniter cartridge.

Pyrogen firings began February 29, 1964, to check out the compatibility of types 2A and 2B hotwire igniter cartridge with the tower jettison motor pyrogen unit. Type 2A cartridges performed successfully in six firings of the original pyrogen without damage to pellet basket or screens. This is the same configuration on which basket or screen damage occurred during several of the six previous full-scale tower jettison motor firings. S&ID recommends the use of this pellet basket on boilerplates 12 and 13 only. A stronger pellet basket screen design is in manufacture and will be tested in the next report period.

Propulsion Subsystem Analysis

Further analysis of the SPS engine assembly shows that a service module temperature control system may be required to control engine component temperatures within established limits, with the exception of the ablative chamber backwall. Investigation is under way to define better the actual ablative backwall temperature rise occurring for various SPS engine firing duty cycles.

Analysis was completed on the thermal effects of the SPS nozzle extension on SPS engine component temperatures. Results showed that a full-size nozzle extension is essential on spacecraft 008 for obtaining valid test data.

Lockheed batch check motor firings were evaluated. Data show an over-all temperature sensitivity of approximately 0.15 percent per degree Fahrenheit over the range from 140 F to 20 F.

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DOCKING AND EARTH LANDING

The alternate docking probe, designed to permit installation and removal without tools, was installed in the crew task mock-up at S&ID Downey. The preliminary checkout was satisfactory for handling and simplicity of operation. The lunar excursion module (LEM) forward hatch configuration was installed for testing.

Two drop tests were made at El Centro to evaluate main parachute systems. In both tests a cylindrical bomb-shaped test vehicle having the same weight as the command module was dropped from 15,000 feet. Drop test 48 employed two parachutes modified with full vertical tapes and redundant reefing. Severe blanketing of one parachute indicated that the addition of the full tapes is detrimental. Drop test 49 was made on March 11, 1964, to evaluate midpanel reefing without vertical tapes. Results were good.

GROUND SUPPORT EQUIPMENT (GSE)

Computer subprogramming requirements for the automatic checkout equipment (ACE) were transmitted to General Electric, the computer program subcontractor. These documents describe the operational requirements for vehicle checkout. The design of the service module external signal conditioning unit is in progress. A total of 232 drawings have been released for the stabilization and control subsystem special test unit. Eleven items of GSE for boilerplate 12 were shipped to White Sands Missile Range (WSMR) on February 21, 1964.

The fluid distribution system control units are being redesigned to reduce size. The new design is to be housed in identical standard "suitcases" instead of consoles. Panel nomenclature will identify each unit for use with a particular fluid distribution system. The new design requires only 24 drawings, compared to 140 for the console design. Total design effort is less than that required to up-date the console drawings to support one boilerplate.

The status of GSE equipment is shown in Table 2.

SIMULATION AND TRAINERS

The dynamic motion simulator (flight table) will undergo acceptance tests at the supplier's facilities. Delivery is expected at S&ID in mid-April. This unit is a hydraulically driven, three-gimbal device upon which inertial and attitude sensors will be mounted. The primary function of the flight table is to perform dynamic ground simulations to verify the performance

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Table 2. Status of Ground Support Equipment Service Systems

Model Number	Nomenclature	Status
SERVICING EQUIPMENT		
C14-427	Fluid Flow Rate Calibration Unit	All mechanical drawings are released. Electrical drawings are 95-percent released.
S14-043	Fluid Distribution System for Propulsion System Development Facility Test Stand I	All design drawings are completed.
HANDLING EQUIPMENT		
A14-149	Atmospheric Controlled Enclosure	Design has started.
H14-017	Weight and Balance Fixture	Design drawings are 95-percent complete.
H14-136	Spacecraft/Service Module Hoisting Fixture	
H14-161	Launch Escape System Motor Propellant Grain Inspection Set	
H14-177	Spacecraft/Service Module Horizontal Weight and Balance Set	
BENCH MAINTENANCE EQUIPMENT (BME)		
A14-044	Nozzle Enclosure (Dust Cover)	Received from Aerojet-General
A14-045	Service Propulsion System Engine Nozzle Plug	
C14-002	Baro-Switch Test Unit	Shipped to WSMR
C14-126	Earth Landing System Sequencer BME	

capability of the sensors in the integrated system. The inertial and attitude sensors transmit control information to computers for engineering computations. The sensors also orient the visual displays to simulate the position of the command module relative to the earth, moon, and other celestial bodies. The inner pitch gimbal will be provided with a saddle capable of supporting the inertial and attitude sensors. Upon command signal, the simulator will be capable of starting, accelerating, and rotating the simulator table through three mutually perpendicular axes. The hydraulic power supply will be located outside the building to prevent the high noise level from affecting the sensors. The power supply will be remotely controlled and monitored from a test engineer's console in each complex.

The command module tilt fixtures for simulators S-1 and S-2 were completed. The S-1 command module and its tilt fixture were assembled and wiring is being installed. The S-2 command module is now being fabricated. When completed, the other tilt fixture will be assembled with the S-2 command module. The tilt fixture is a device capable of tilting the simulator command module forward to a 30-degree angle to enable a crew couch occupant to position his feet lower than his head, if necessary for comfort.

VEHICLE TESTING

The shipment of boilerplate 12 to WSMR was completed February 27, except for two GSE items, the pyro initiator substitute set and the service module adapter. Both items require modification prior to shipment. Seven modification kits were shipped, three are ready to ship, and three are being manufactured. Changes are being made to eliminate the possibility of an accidental abort by providing an additional relay that must close simultaneously with the existing relay to initiate an abort.

The wiring mock-up of boilerplate 14 was completed and cable is being manufactured. Command module plumbing is 30 percent complete; service module plumbing is 80 percent complete.

Drop test 10 was made with boilerplate 19 at El Centro on February 27 in support of the boilerplate 12 program. The purpose was to observe the integrity of the exposed main parachute retention system and the rotation of the command module from an apex-forward attitude at a dynamic pressure of approximately 120 pounds psf. All systems functioned as planned, with good correlation between predicted and actual aerodynamics.

Boilerplate 23 is in the final stages of assembly. Incorporation of all engineering orders, stacking, and alignment are scheduled to be completed early in April.

[redacted]

The mock-up of the spacecraft 001 electrical harness was completed. The ECS plumbing is 30 percent complete. SPS tanks were received and checked for fit in the service module.

RELIABILITY

An analysis was made of the comparative reliability of four proposed configurations for the cryogenic storage system pressure control circuit. The configurations and analysis results are given in Table 3. The analysis showed that the two circuits with manual override have better inherent reliability. There is no significant difference between the direct wire and the motor switch circuits.

Design, weight, and reliability considerations are being evaluated.

Table 3. Reliability Analysis of Cryogenic Storage System Pressure Control Circuits

Circuit	Failures Per 10^6 Missions
Direct wire with manual override	30
Motor switch with manual override	53
Direct wire with no manual override	194
Motor switch with no manual override	217

A mission planning task force meeting was held at Grumman. S&ID presented a list of functions for which backup capability between the command and service module and the lunar excursion module would benefit performance and reliability. To develop such backups, the following pertinent data are to be exchanged: mission timelines, results of contingency analyses, and logic diagrams for mission success and crew safety, including failure rates and equipment duty cycles.

TECHNICAL OPERATIONS

The Apollo Spacecraft Development Test Plan Study Report was published with the cooperation of Grumman and MIT. The five-volume report provides the basis for integrated testing of the space vehicle developed by S&ID, the lunar excursion module developed by Grumman, and the guidance and navigation system developed by MIT.

Command module mock-up 22 was completed on February 28, 1964. This mock-up is to be delivered to NASA.

OPERATIONS

DOWNEY

Boilerplate 12

The integrated systems checkout for boilerplate 12 was completed successfully and the assembled boilerplate spacecraft was accepted by both NASA and S&ID. The assembly was then demated and transferred to the test preparation area where horizontal weight and balance checks and shipping preparations were completed.

The checkout GSE and the launch escape system, minus the inert motors, were shipped to WSMR by truck on February 23, 1964. The service module and additional GSE were shipped via the B-377PG aircraft on February 26, 1964. The LES tower legs, the remaining GSE, and the command module were also shipped via the B-377PG on February 28.

The service module extension and the GSE pyro simulator unit were retained at the Downey facility for rework. This rework was required to increase the structural integrity of the blast barrier in the service module extension. The pyro simulator unit was reworked to increase the sensitivity of transient circuits within the 30 breakout boxes. The reworked extension and simulator units were then shipped to WSMR on March 10, 1964.

Boilerplate 13

The service module and some items of GSE were air shipped to the Florida facility on February 15. The command module, forward heat shield, and associated GSE were shipped on February 17.

Boilerplate 15

On March 6, boilerplate 15 was transferred to Apollo Test and Operations. A period of boilerplate up-dating and modification was initiated.

The boilerplate cable set was received from the Slauson facility; 79 of the 80 cables have passed validation checkout.

Rework of the service module platform components was initiated to allow proper assembly of the platform. The configuration of the components interfered with the service module ballast installation.

The detail work schedule for boilerplate 14 will be up-dated, and the integrated checkout procedure using STU (systems test unit) will be prepared during the next period.

Boilerplate 15 will be up-dated and prepared for testing. Detail system testing will be initiated during the next period.

Planning effort to determine the requirements for boilerplates 16 and 26 and spacecraft 001, 006, 008, and 009 will be continued.

WHITE SANDS MISSILE RANGE

Mission Abort

The launch escape and pitch control motors for the boilerplate 12 mission abort launch arrived at WSMR, and receiving inspection was completed. The pitch control and tower jettison motor leak checks and the launch escape motor grain inspection were accomplished. Buildup of the launch escape subsystem structure was initiated; the pitch control motor and ballast structures were mated to the jettison motor unit, and the tower skirt installed. The tracking pattern was painted on the motor case, and the first and second coats of the wire harness bonding material were applied. Installation of the Q-ball and the pitch control motor hardware was completed.

The boilerplate 12 command and service modules and associated GSE arrived at WSMR, and receiving inspection was completed. The boilerplate was moved to the vertical assembly building, and test preparation was initiated.

The installation of electrical components of the mission abort post-launch checkout console was continued.

The earth landing system buildup, command module horizontal and vertical weight and balance, and thrust vector alignment will be completed during the next report period.

The service module modifications will be completed, and the module will be mated to the Little Joe II launch vehicle on the mission abort pad. The stacked configuration checkouts will be completed.

The command module will be moved to the launch pad and mated to the service module. The systems checkouts will be conducted on the stacked configuration.

Propulsion Systems Development Facility (PSDF)

Fabrication of the wiring harness is continuing for the test fixture F-2 interim firing panel console and console J-box. The electrical subcontractor completed the application of terminations (lug and ferrules) to the harness at the J-box. Installation of the completed portions of the harness was initiated.

The installation and alignment of the PSDF test stand thrust measurement system was completed.

The PSDF 100-hour acceptance test of the data acquisition system analog subsystem was successfully completed. The digital subsystem acceptance test was terminated because of excessive output level drift. After the analog-to-digital converter was reworked, the digital subsystem 100-hour acceptance test was rerun and successfully completed. Data reduction for the acceptance testing has been initiated.

The PSDF test fixture F-2 functional checkouts and leak-checks will be performed during the next report period. Verification of the PSDF instrumentation system wiring installation will be accomplished. The test fixture F-2 engine will be received, and receiving inspection will be performed.

FLORIDA FACILITY

Boilerplate 13

The command module, service module, and associated LES and GSE arrived at the Florida facility and were unloaded. Receiving inspection of the boilerplate was accomplished at Hangar AF. A fit-check of the adapter and the S-IV instrument unit has verified the physical fit of those units. The command module cleanup and modification and the service module test preparation operations were initiated.

The nozzles of the LES motor were removed, the instrumented skirt was installed, and the nozzles were replaced. The motor was placed on the work stand, and LES buildup was initiated. The tower jettison and pitch control motors and forward assembly were then mated to the LES motor and the electrical-bonding continuity checks completed. The completed LES was then placed on a handling trailer and moved to Hangar AF for the spacecraft system tests.

[redacted]

The spacecraft/complex compatibility testing was satisfactorily completed on March 10, 1964.

Following the spacecraft/complex compatibility testing, the LES was moved from Hangar AF to the hazardous storage area where it will remain until the integrated systems checkout begins.

General

All interfaces of the breadboard automatic checkout equipment (ACE) digital test monitor system were completed. Simulated data were sent from the signal simulator to the lunar excursion module data channels of the interleaver. The data were interleaved and sent to the experimental ground station for decommutation, display on the cathode ray tube (CRT) unit, and recording on tape. Printouts were also made in order to verify the data on the tape against the CRT display.

The checkout operations for boilerplate 13 will continue during the next report period. Integrated systems checkout at Hangar AF will be completed. The installation and checkout of GSE for launch complex 39 will be accomplished. The Operations Plan and the Operations Requirements Documents will be completed and published.

TEST PROGRAM SUPPORT

The Q-ball computer program was incorporated as a "chain-link" portion to the boilerplate 13 trajectory computer program. This is in addition to the orbital parameters computer program.

The Apollo interim data station now has the added capability of digitizing commutated data coincident with oscillographic recording. The Apollo telemetry ground station linearity check computer program was modified to accept a variety of input formats.

Improved calibration data flow procedures will be formulated and the data processing standard procedures will be completed during the next period. The data storage-retrieval system will be further implemented.

FACILITIES

DOWNEY

Systems Integration and Checkout Facility

Construction of the systems integration and checkout facility is essentially complete, with the balancing of the air conditioning system the only major item of work remaining. Installation of telephone service began on March 11, 1964. Design work to support systems integrated test equipment, automatic checkout equipment, and general occupancy continues in various stages of completion.

Space Systems Development Facility

The general construction of the space systems development facility is approximately 88 percent complete. Mechanical piping and air conditioning work is proceeding rapidly. The estimated over-all completion date is March 22, 1964.

Tube Cleaning Facility

The site and foundation portion of the tube cleaning facility building is complete. Structural steel, metal siding, and roofing installation are continuing. The facility is approximately 55 percent complete and the operational ready date is scheduled April 1, 1964. (See Figure 3.)

INDUSTRIAL ENGINEERING

Occupancy of Systems Integration and Checkout Facility

All checkout and integration manufacturing operations were relocated during the report period. Combined integrated systems checkout and systems modifications are being performed on boilerplates 014 and 026.

Transporter Module

A cost proposal was prepared for the facilities required to support the assembly of three transporter modules at the Downey facility. These adapters will be fabricated, pre-assembled, and disassembled at Tulsa and then shipped to Downey for assembly and test.

[redacted]

Consolidation of Apollo GSE at Ferguson

A plan has been completed to locate the following Apollo departments at Ferguson:

GSE Engineering
Logistics GSE Engineering
GSE-SMD Fabrication
Electrical/Electronic Fabrication and Checkout

Approximately 1100 office personnel were moved by March 13, 1964.

The relocation of Apollo manufacturing activities at Ferguson will begin at the end of April. The final occupancy will be approximately September 1.

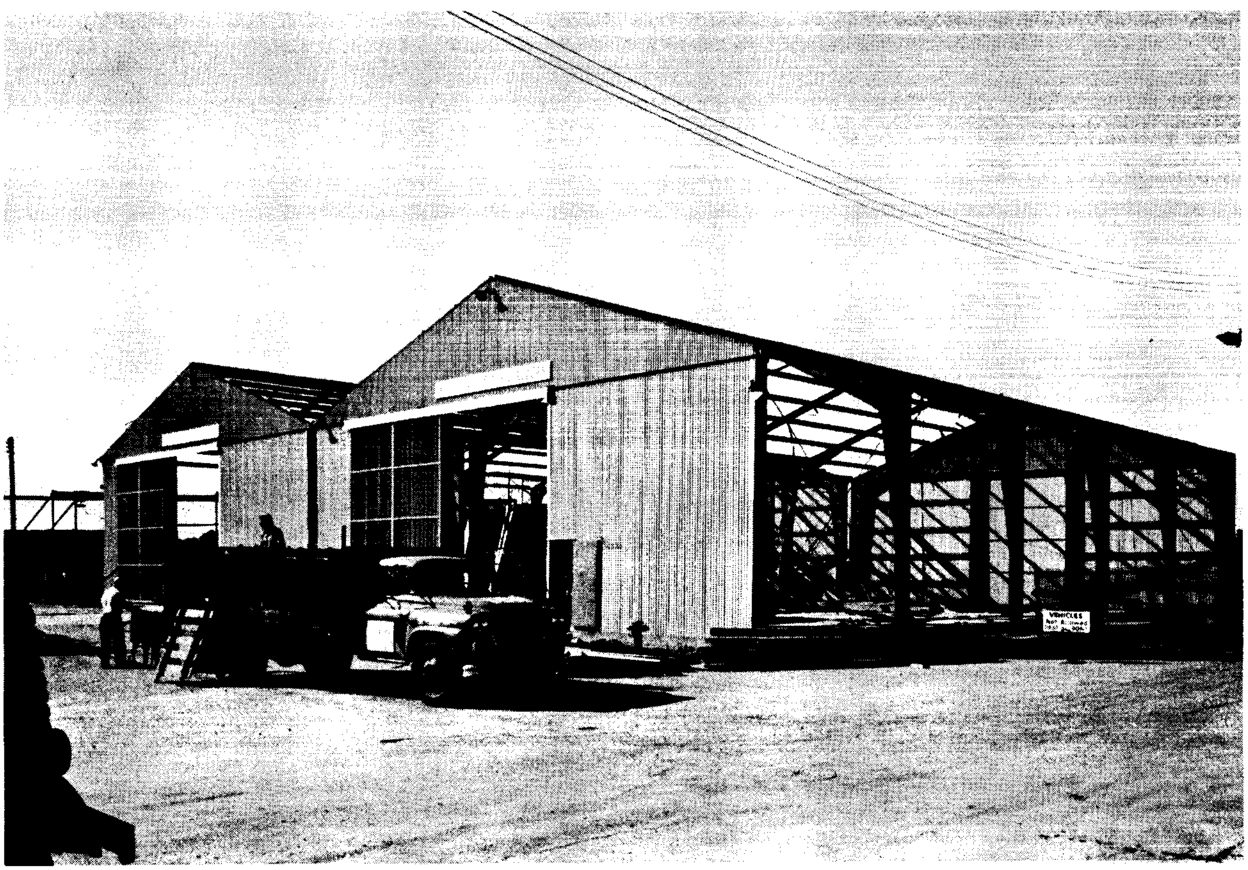

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Figure 3. Tube Cleaning Facility

APPENDIX

S&ID SCHEDULE OF APOLLO MEETINGS AND TRIPS

[redacted]

S&ID Schedule of Apollo Meetings and Trips
February 16 to March 15, 1964

Subject	Location	Date	S&ID Representatives	Organization
Dynamic stability program coordination	Sacramento, California	February 16, 1964	Mower	S&ID, Aerojet
Boilerplate 13 checkout and launch activities support	Cocoa Beach, Florida	February 16, 1964	Nichols	S&ID, NASA
Integrated circuit preliminary design review	Princeton, New Jersey	February 16, 1964	Green	S&ID, RCA
Model design review	Minneapolis, Minnesota	February 16, 1964	Downes, Fritzinger	S&ID, Honeywell
Boilerplate 13 operations coordination	Cocoa Beach, Florida	February 16, 1964	Mohr	S&ID, NASA
IFTS monthly coordination meeting and review	Chicago, Illinois	February 16, 1964	Bartholomew, Smith, Grossman, Villafan	S&ID, ITT
Monthly coordination meeting	Boulder, Colorado	February 16, 1964	Carter, Johnson, Cooke, Manyak, Bouman, Pohlen	S&ID, Beech
Communications and data BME design review	Cedar Rapids, Iowa	February 17, 1964	McCredie	S&ID, Collins
Navigation and guidance requirements meeting	Houston, Texas	February 17, 1964	Louie, Cooper, Ruggiero, Knotts	S&ID, NASA
Stability information briefing	Sacramento, California	February 17, 1964	Field	S&ID, Aerojet
Full-scale docking test presentation	Houston, Texas	February 17, 1964	Piroutek, Witters	S&ID, NASA
Static wiring complex meeting	Cocoa Beach, Florida	February 17, 1964	Ridlon	S&ID, NASA
Heat shield coordination meetings	Lowell, Massachusetts	February 17, 1964	MacQuiddy	S&ID, Avco
Up-data link design review	Houston, Texas	February 17, 1964	Covington, Kolb	S&ID, NASA
Contract proposal coordination	Houston, Texas	February 17, 1964	Rzyski	S&ID, NASA
Model design review	Cedar Rapids, Iowa	February 17, 1964	Marine, Griffiths, Kronsberg	S&ID, Collins
Project engineering support of field operations	Cocoa Beach, Florida	February 17, 1964	Eslinger, Hartzel	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
GSE systems panel meeting	Cape Kennedy, Florida	February 17, 1964	Wright, Dusablon	S&ID, NASA
Crew systems docking visual requirements briefing	Houston, Texas	February 17, 1964	Beam, Humes, Neatherlin	S&ID, NASA, Grumman
Abort and ground propulsion test operations engineering support	Las Cruces, New Mexico	February 17, 1964	Garcia	S&ID, NASA
Contractual discussions	Bethpage, New York	February 17, 1964	Sack	S&ID, Grumman
Critical shortages expediting meeting	Chicago, Illinois	February 17, 1964	Scott	S&ID, Cannon
Mission planning task force meeting	Cocoa Beach, Florida	February 17, 1964	Linsday	S&ID, NASA
Full-scale docking test proposal presentation	Houston, Texas	February 17, 1964	Neatherlin, Underwood, Bohlen, Frohoff	S&ID, NASA
Handling flow diagrams discussion	Houston, Texas	February 17, 1964	Hillberg, Lilian	S&ID, NASA
Test acceptance program discussion	Fairborne, Ohio	February 17, 1964	McIntyre, Neff	S&ID, NASA, USAF
Motor performance discussion	Elkton, Maryland	February 17, 1964	Yee	S&ID, Thiokol
Spacecraft wire insulations, discussions and coordination	Bethpage, New York	February 18, 1964	Johnson, Smith	S&ID, Grumman
Audio equipment investigation	Cedar Rapids, Iowa	February 18, 1964	Lee	S&ID, Collins
Boilerplate 13 operations support	Cocoa Beach, Florida	February 18, 1964	Metz, Baker, Otts, Griffith	S&ID, NASA
Design review presentation	Houston, Texas	February 18, 1964	Sweet, Barbour, Rooten, Moeller, Miller	S&ID, NASA
Tooling surveillance	Nashville, Tennessee	February 18, 1964	Smith	S&ID, Avco
Revised procurement specification technical discussion	Sunnyvale, California	February 19, 1964	Hardaway, Farr	S&ID, Thermatest Laboratories
Design review meeting	Cedar Rapids, Iowa	February 19, 1964	Himmelberg, Barrier, Moore	S&ID, Collins
Schedule status review	Middletown, Ohio	February 19, 1964	Stover, Daily	S&ID, Aeronca

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S&ID Schedule of Apollo Meetings and Trips
February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Communication and instrumentation subsystem management meeting	Houston, Texas	February 19, 1964	Jones, Page	S&ID, NASA
Engineering coordination meeting	Boulder, Colorado	February 19, 1964	Haglund	S&ID, Beech
Procurement specification analysis and technical discussion	Sunnyvale, California	February 19, 1964	Farr, Travis	S&ID, Thermatest Laboratories
Operations coordination meeting	Cocoa Beach, Florida	February 19, 1964	Dorman	S&ID, NASA
Test support of boilerplate 13	Cocoa Beach, Florida	February 19, 1964	DeVore	S&ID, NASA
Service propulsion engine, parts procurement meeting	Sacramento, California	February 19, 1964	Cadwell	S&ID, Aerojet
Boilerplate 13 buildup coordination	Cocoa Beach, Florida	February 20, 1964	Smith	S&ID, NASA
Heat transfer tests	Hampton, Virginia	February 20, 1964	Emerson	S&ID, NASA
Interface control document coordination	Cocoa Beach, California	February 20, 1964	Brilliant	S&ID, NASA
Implementation plan meeting	Sacramento, California	February 20, 1964	Colston, Klitsche	S&ID, Aerojet
Test data discussion	Seattle, Washington	February 20, 1964	Ullery	S&ID, Boeing
Program briefing	Houston, Texas	February 20, 1964	Osbon, Skene, Cole	S&ID, NASA
Design engineering inspection and coordination meeting	East Hartford, Connecticut	February 21, 1964	Garnett	S&ID, NASA
Monthly coordination meeting	Ann Arbor, Michigan	February 21, 1964	Dykstra, Westfall, Parry, Pratt	S&ID, Bendix
Installation and qualification test coordination	Ann Arbor, Michigan	February 21, 1964	Tedisco	S&ID, Bendix
Supplier engineering support	Middletown, Ohio	February 22, 1964	Soja	S&ID, Aeronca
Engineering mechanical details discussion	Denver, Colorado	February 22, 1964	Minick	S&ID, Comcor
PERT details meeting	Binghamton, New York	February 22, 1964	Clancy, Finley	S&ID, General Precision

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S&ID Schedule of Apollo Meetings and Trips
February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
High-gain antenna technical and administrative management review	Woodside, New York	February 23, 1964	Mihelich	S&ID, Avien
Management program review	Woodside, New York	February 23, 1964	Matisoff	S&ID, NASA
Critical shortage expediting meeting	Springhouse, Pennsylvania	February 23, 1964	Kennedy	S&ID, Moore
ICD's coordination and rework	Las Cruces, New Mexico	February 23, 1964	Suddarth, Ragusa	S&ID, NASA
Mission simulator fact-finding analysis	Binghamton, New York	February 23, 1964	Hatchell, Parrish	S&ID, General Precision
Boilerplate 13 support	Cocoa Beach, Florida	February 24, 1964	Fillbach	S&ID, NASA
Engineering liaison effort	Cocoa Beach, Florida	February 24, 1964	Reinhart	S&ID, NASA
Monthly coordination meeting	E. Hartford, Connecticut	February 24, 1964	Pohlen	S&ID, Pratt & Whitney
Computer loading and visual control meeting	Binghamton, New York	February 24, 1964	Fairchild, Brown	S&ID, General Precision
SPS instability discussions	Cleveland, Ohio	February 24, 1964	Simkin, Beltran, Gluck, Koppang	S&ID, Lewis Research Center, NASA
ECS and cryogenic facility meeting	Cape Kennedy, Florida	February 24, 1964	Margetan, Goggins	S&ID, NASA
Engineering coordination meeting	Las Cruces, New Mexico	February 24, 1964	White, Batson	S&ID, NASA
GSE delivery and installation coordination	Las Cruces, New Mexico	February 24, 1964	Goldstein	S&ID, NASA
Special purpose connector investigation	Albuquerque, New Mexico	February 24, 1964	Fleck	S&ID, AEC, NASA
Crew safety system panel meeting	Houston, Texas	February 24, 1964	Vucelic, Courtis, Helms, Geheber	S&ID, NASA
Human engineering criteria, coordination and integration	Bethpage, New York	February 24, 1964	Boehlke, Rourke	S&ID, Grumman
Test data working group meeting	Bethpage, New York	February 25, 1964	Rutowski, Phillips, Wellens, Stratton, Bunce	S&ID, Grumman
S-IVB interface meeting	Minneapolis, Minnesota	February 25, 1964	Kalayjian, Witsmeer	S&ID, Honeywell
Contract administration meeting	Sacramento, California	February 25, 1964	Colston, Borde	S&ID, Aerojet

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S&ID Schedule of Apollo Meetings and Trips February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Monthly coordination meeting	Indianapolis, Indiana	February 25, 1964	Bucuvalas	S&ID, Allison
Launch escape motor grain inspection	Las Cruces, New Mexico	February 25, 1964	Powers	S&ID, NASA
Space suit mobility demonstration	Windsor Locks, Connecticut	February 25, 1964	Roebuck	S&ID, Hamilton Standard
Battery activation engineering support	Cocoa Beach, Florida	February 26, 1964	Vallin	S&ID, NASA
Test objectives and requirements presentation	Houston, Texas	February 26, 1964	Aber	S&ID, NASA
NASA coordination meeting	Dayton, Ohio	February 26, 1964	Armstrong	S&ID, NASA, USAF
Test planning definition, discussion	Houston, Texas	February 26, 1964	Foust, Robinson	S&ID, NASA
Lunar excursion module guidance meeting	Houston, Texas	February 26, 1964	Hedvig	S&ID, NASA
Honeycomb panel coordination meeting	Middletown, Ohio	February 26, 1964	King	S&ID, Aeronca
Technical coordination meeting	San Carlos, California	February 27, 1964	Lazarus, Wagner, Stuzowski, Whitted, Bell, Flanigan	S&ID, Pelmec
Monthly contract coordination meeting	Menlo Park, California	February 27, 1964	Hair, Osborne, Dziedziula, Anninos	S&ID, Stanford Research Institute
Trajectory subpanel meeting	Houston, Texas	February 27, 1964	Myers, Agajanian, Kakuske	S&ID, NASA
Configuration control meeting	Las Cruces, New Mexico	February 27, 1964	Kosovich	S&ID, NASA
Communication requirements discussion	Bethpage, New York	February 29, 1964	Whitanis, Albinger	S&ID, Grumman
Dynamic stability program coordination	Sacramento, California	March 1, 1964	Mower	S&ID, Aerojet
Engineering field support	Cocoa Beach, Florida	March 1, 1964	McGee	S&ID, NASA
Test data review	E. Hartford, Connecticut	March 1, 1964	Cooke	S&ID, Pratt & Whitney
VHF antenna relocation discussion	Houston, Texas	March 1, 1964	McQuerry	S&ID, NASA
Interface control drawing discussion and meeting	Bethpage, New York	March 1, 1964	Ridlon	S&ID, Grumman

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S&ID Schedule of Apollo Meetings and Trips
February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Operations coordination meeting	Cocoa Beach, Florida	March 1, 1964	Calvert	S&ID, NASA
Conduct heat transfer wind tunnel test	Hampton, Virginia	March 1, 1964	Biss	S&ID, NASA
Electrical power systems engineering support	Cape Kennedy, Florida	March 1, 1964	Otzinger	S&ID, NASA
Bladder failure investigation, review	Buffalo, New York	March 2, 1964	Whiting	S&ID, Bell
FSJ-3 testing	Tullahoma, Tennessee	March 2, 1964	Moots	S&ID, NASA
PV-5 burst test	Boulder, Colorado	March 2, 1964	Haglund	S&ID, Beech Aircraft
Meteoroid shielding weight penalties, meeting	Houston, Texas	March 2, 1964	Stone, Jones, Devine	S&ID, NASA
Mechanical integration panel meeting	Huntsville, Alabama	March 2, 1964	Stone, Warner, Li, Whalen	S&ID, NASA
S-band system testing discussion	Scottsdale, Arizona	March 2, 1964	Hall, D'Ausilio	S&ID, Motorola
Analog computer and linkage system discussion	Denver, Colorado	March 2, 1964	Gonzalez, Wheeldon, Bruhn	S&ID, Comcor
Sampling plan implementation investigation	Lima, Ohio	March 2, 1964	Collins	S&ID, Westinghouse
Schedule acceleration discussion	Rolling Meadows, Illinois	March 2, 1964	Pope, Greenfield, Moore, Covington	S&ID, Elgin
Production and schedule problems	Middletown, Ohio	March 2, 1964	Halverson, Eberhardt	S&ID, Aeronca
Quality control activities coordination	Las Cruces, New Mexico	March 2, 1964	Griffith-Jones	S&ID, NASA
Simulation flight table status check	Shawnee, Oklahoma	March 2, 1964	Herschberg	S&ID, Shawnee
Apollo site activation plan, discussion	Houston, Texas	March 3, 1964	Pinkham, Lane	S&ID, NASA
Canard wind tunnel tests, coordination	Houston, Texas	March 3, 1964	Allen	S&ID, NASA
Mission planning task force	Houston, Texas	March 3, 1964	Meston	S&ID, NASA
Trainer systems meeting	Houston, Texas	March 3, 1964	Flatto, Matthews, Mooney	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Site activation discussions	Houston, Texas	March 3, 1964	Shelley	S&ID, NASA
Central timing equipment review	Rolling Meadows, Illinois	March 3, 1964	Schiavi, Pope, Moore, Covington	S&ID, Elgin
IFTS design redirection	Chicago, Illinois	March 3, 1964	Puterbaugh, Smith	S&ID, ITT
Relations discussion	Cambridge, Massachusetts	March 3, 1964	Kennedy	S&ID, MIT
Preflight field testing	WSMR, New Mexico	March 4, 1964	Jackson	S&ID, NASA
Heat transfer wind tunnel test	Hampton, Virginia	March 4, 1964	Emerson	S&ID, NASA
Handling and auxiliary equipment support	Las Cruces, New Mexico	March 4, 1964	Frank	S&ID, NASA
Boilerplate 13 signal/ function list presentation	Cocoa Beach, Florida	March 4, 1964	Zulka	S&ID, NASA
Service module destruct system design review	Cocoa Beach, Florida	March 4, 1964	Barbour, Miller, Moeller, Rooten, Sweet	S&ID, NASA
Up-data link bench maintenance equipment	Scottsdale, Arizona	March 4, 1964	Downes, Kolb, Skelton	S&ID, NASA
Vibration testing facilities discussion	Houston, Texas	March 4, 1964	Crumal, Kiefer	S&ID, NASA
CO_2 measurement system meeting	Houston, Texas	March 5, 1964	Ross	S&ID, NASA
Contract administration meeting	Sacramento, California	March 5, 1964	Colston	S&ID, Aerojet
FSJ-3 testing	Tullahoma, Tennessee	March 5, 1964	Daileda	S&ID, NASA
Block I-A and canard review	Houston, Texas	March 5, 1964	Burley, Pearce, Petrey, Ryker, Walkover	S&ID, NASA
Facility contract discussions	Houston, Texas	March 5, 1964	Katz	S&ID, NASA
S-band klystron development	San Carlos, California	March 5, 1964	Hall, Pope	S&ID, Litton
Boilerplate 13 test operations	Cocoa Beach, Florida	March 5, 1964	Jolley	S&ID, NASA
Boilerplate 13 checkout support	Cocoa Beach, Florida	March 5, 1964	Sharpe	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Boilerplate 12 configuration control coordination	WSMR, New Mexico	March 6, 1964	Webster	S&ID, NASA
Prequalification flight drop tests	El Centro, New Mexico	March 6, 1964	Bielefeld, Young	S&ID, NASA, USN
Boilerplate 13 project office support	Cocoa Beach, Florida	March 6, 1964	Harris	S&ID, NASA
Gauging system and design review	Tarrytown, New York	March 7, 1964	McKellar	S&ID, Simmonds
Flight mechanics, dynamics, and control panel meeting	Houston, Texas	March 8, 1964	Lucas, Geheber	S&ID, NASA
Engineering support for boilerplate 13	Cocoa Beach, Florida	March 8, 1964	Lindsay	S&ID, NASA
Delta corrections implementation	Cedar Rapids, Iowa	March 8, 1964	Shear	S&ID, Collins
Honeycomb panels meeting	Middletown, Ohio	March 8, 1964	Harrison	S&ID, Aeronca
Cryogenics meeting	Cocoa Beach, Florida	March 8, 1964	Nelson, Wright	S&ID, NASA
Procurement specification negotiation	Lowell, Massachusetts	March 9, 1964	Lowery	S&ID, Avco
Procurement specification negotiation	Middletown, Ohio	March 9, 1964	Eberhardt	S&ID, Aeronca
Spacecraft reactant purity requirements meeting	Cape Kennedy, Florida	March 9, 1964	Nelson, Nash, Bouman, Fisher, Wechsler	S&ID, NASA
Precontract negotiation and engineering support review	Wilmington, Maryland	March 9, 1964	Lowrey, Farr	S&ID, Avco
Management review of schedules	Princeton, New Jersey	March 9, 1964	Hagelberg	S&ID, RCA
Monthly coordination meeting	Lima, Ohio	March 9, 1964	Symons	S&ID, Westinghouse
Project engineering coordination	Sacramento, California	March 9, 1964	Mower, Borde	S&ID, Aerojet
Fuel cell and cryogenic conference	Cocoa Beach, Florida	March 9, 1964	Pohlen	S&ID, NASA
Ordnance devices engineering liaison	White Sands, New Mexico	March 9, 1964	Teter	S&ID, NASA
Boilerplate 12 installation	Las Cruces, New Mexico	March 9, 1964	Byrd	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
BME acceptance test	Minneapolis, Minnesota	March 9, 1964	Pimple	S&ID, Honeywell
Weight review meeting	Sacramento, California	March 9, 1964	Klitsche	S&ID, Aerojet
Monthly coordination meeting	Lima, Ohio	March 9, 1964	Shelly, Vermill, Dempsey, Rood, Hulley	S&ID, Westinghouse
Pretest conference	Mountain View, California	March 10, 1964	Cameron	S&ID, Ames Research Center
Status review briefing	Buffalo, New York	March 10, 1964	Gibb, Wagner, Moore	S&ID, Bell
Schedule discussion	Houston, Texas	March 10, 1964	Perkins	S&ID, NASA
Test site activation discussions	Cocoa Beach, Florida	March 10, 1964	Pinkham	S&ID, NASA
Processing of installation coordination	White Sands, New Mexico	March 10, 1964	Knoll	S&ID, NASA
Contract negotiation	Houston, Texas	March 10, 1964	Lashbrook	S&ID, NASA
Cost quotation negotiation	Princeton, New Jersey	March 10, 1964	Doll	S&ID, RCA
Subcontractor performance review	Sacramento, California	March 11, 1964	Beck	S&ID, Aerojet
Off-site activities effort negotiations	Houston, Texas	March 11, 1964	Drucker, Pearce, Wilson	S&ID, NASA
Technical coordination meeting and management review	Melbourne, Florida	March 11, 1964	Whitehead, Rosenthal	S&ID, Radiation
Dual mode explosive bolt negotiations	Edwardsville, Illinois	March 11, 1964	Jennings	S&ID, Propellex
Superinsulation discussions	E. Hartford, Connecticut	March 11, 1964	Davis	S&ID, Pratt & Whitney
Communication functional requirements discussion	Houston, Texas	March 11, 1964	Page, Tyner, Covington	S&ID, NASA
Multiple gas connector meeting	Windsor Locks, Connecticut	March 11, 1964	Gould, Roentgen	S&ID, Hamilton Standard
Service propulsion system dynamic stability	Houston, Texas	March 11, 1964	Bellamy, Simkin, Beltran, Wolfelt	S&ID, NASA
Witness pyrogen firings and review data	Elkton, Maryland	March 11, 1964	Sumner	S&ID, Thiokol

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S&ID Schedule of Apollo Meetings and Trips
February 16 to March 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
R&D telemetry antenna coordination	White Sands, New Mexico	March 11, 1964	Womack	S&ID, NASA
Design review meeting	Sacramento, California	March 11, 1964	Field, Ross, Cadwell, Goldstein	S&ID, Aerojet
Technical coordination and design review	Princeton, New Jersey	March 11, 1964	Kolb	S&ID, RCA
GSE finish and color problems, discussion	Houston, Texas	March 11, 1964	Boehlke	S&ID, NASA
Quality verification vibration and testing plan presentation	Houston, Texas	March 11, 1964	Jacobson, Robinson, Yorgiadis, Kiefer, Long	S&ID, NASA
Boilerplate 12 actual weight and balance performance	White Sands, New Mexico	March 11, 1964	Mann	S&ID, NASA
SPS fuel tank qualification test	Ann Arbor, Michigan	March 12, 1964	Bojic	S&ID, Bendix
Special tooling package preparation, assistance	Sacramento, California	March 15, 1964	Petr	S&ID, Aerojet

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